METHODS AND APPARATUS FOR DEMODULATION OF A SIGNAL IN A SIGNAL SLOT SUBJECT TO A DISCONTINUOUS INTERFERENCE SIGNAL

BACKGROUND OF THE INVENTION

The present invention relates generally to digital communications, and, more particularly, to methods and systems for demodulating a received signal.

Various approaches have been developed for demodulating a received signal. For a conventional (single user) receiver it is known to use single or uni-directional demodulation. Bi-directional demodulation has also been proposed to improve performance using multiple known fields within the received signal as described in United States Patent Nos. 5,335,250 and 5,400,362. Furthermore, as described in United States Patent No. 5,909,465, the performance of the bi-directional demodulation can be enhanced by performing a first demodulation pass, calculating figure of merit (quality) values related to this demodulation, choosing demodulation directions for each sub-block of unknown data based upon these figures of merit, and then performing a second demodulation pass.

Joint demodulation or interference cancellation may be used as an alternative to single user demodulation to handle co-channel interference in communication systems, such as time division multiple access (TDMA) systems. Joint demodulation may be used to detect two or more signals that are received over a common channel. For example, joint demodulation may be used to detect a desired signal from a received signal that includes an interfering signal. In joint demodulation, the desired signal and the interfering signal are typically jointly demodulated based on information concerning the desired signal and the interfering signal, so as to obtain a better estimate of the desired signal.

Two-user joint demodulation for ANSI IS-136 TDMA mobile terminals has been proposed for cancellation of a dominant interfering signal under the assumptions of a flat, slow fading downlink channel environment. By subtracting off the interfering signal, the desired signal's bit error rate may be improved. This occurs where the channel and symbol data corresponding to the interfering signal are not correlated with the desired signal, thereby allowing separation of the two signals. Joint demodulation may, therefore, rely upon the ability to generate channel estimates and perform symbol detection for both the desired signal and the interfering signal. Detection of the desired signal may be improved, therefore, due to improved detection and cancellation of the interfering signal.

Interference cancellation may also be performed by spatial discrimination of the interferer relative to the desired signal if multiple receive antennas are available. However, for systems such as the TDMA IS-136 system, it has been proposed to allow downlink power control on a time-slot basis. This may impact interference cancellation approaches as the time-slots are not necessarily slot-aligned. Thus, the interferer power level may change, or even disappear, during the desired signal's slot. In general, interference cancellation approaches will have some loss, relative to the conventional demodulation approaches, when no interferer is present. Even more dramatic performance losses may occur when the interferer changes its power level abruptly, as different quantities (such as channel estimates or impairment covariance matrices) are typically used during demodulation of the slot. Even if these estimates are updated adaptively, the adaptation rate is typically not fast enough to withstand a sudden step change in the interferer characteristics.

SUMMARY OF THE INVENTION

Embodiments of the present invention include methods and systems for processing a received signal including receiving the signal to provide a sequence of symbols associated with the received signal in respective ones of a plurality of symbol positions. A known block of the sequence of symbols containing known symbol values and an unknown block of the sequence of symbols containing unknown symbol values are identified. A desired demodulation type is determined for use in demodulating the known block based on the known symbol values. An interferer signal characteristic discontinuity location in the unknown block is detected. The

unknown block is demodulated using a first selected demodulation type between the interferer signal characteristic discontinuity and the known block and a second selected demodulation type on another portion of the unknown block, the first selected demodulation type and the second selected demodulation type being selected based on the determined desired demodulation type for use in demodulating the known block and the detected interferer signal characteristic discontinuity.

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BRIEF DESCRIPTION OF THE DRAWINGS

Other features of the present invention will be more readily understood from the following detailed description of specific embodiments thereof when read in conjunction with the accompanying drawings, in which:

Figure 1 is a schematic of an exemplary radiotelephone communication system including demodulation of a signal slot subject to a discontinuous interference signal in accordance with embodiments with the present invention;

Figures 2-3 are schematic illustrations of desired (D) and interfering (I) signals which may be processed in accordance with embodiments of the present invention;

Figure 4 is a block diagram of a receiver system in accordance with embodiments of the present invention;

Figure 5 is a block diagram of a receiver system in accordance with further embodiments of the present invention;

Figure 6 is a flowchart illustration of operations related to processing a received signal for embodiments of the present invention having an unknown field between two known fields;

Figure 7 is a flowchart illustration of operations related to processing a received signal for embodiments of the present invention having a single known field;

Figure 8 is a flowchart illustration of operations related to processing a received signal for further embodiments of the present invention;

Figure 9 is a schematic and flowchart illustration of operations related to processing a received signal using multi-pass demodulation according to further embodiments of the present invention;